5 Nutrients we need in our body every day.

What do you need to eat to have a healthier diet and life? If you're like 62% of Americans according to a WebMD survey they are lacking in 5 important nutrients for a healthier life. Remember ACE (Vitamin A, vitamin C, and Vitamin E). We also need two important minerals Magnesium and Potassium. The 3 vitamins help protect our body by counteracting free radicals which can damage our cells and the insides of our arteries. The two minerals help with specific body functions like muscle/nerve functions, blood glucose control, protein synthesis to name a few.

At the conclusion, I'll provide a simple recipe that contains all five important nutrients. You can use this at any meal or complete this combination over a day of food intake.

ACE MP: Vitamin A, vitamin C, vitamin E, Magnesium, Potassium

Vitamin A

What is vitamin A and what does it do?

Vitamin A is a fat-soluble vitamin that is naturally present in many foods. Vitamin A is important for normal vision, the immune system, and reproduction. Vitamin A also helps the heart, lungs, kidneys, and other organs work properly.

There are two different types of vitamin A. The first type, preformed vitamin A, is found in meat, poultry, fish, and dairy products. The second type, provitamin A, is found in fruits, vegetables, and other plant-based products. The most common type of provitamin A in foods and dietary supplements is beta-carotene.

How much vitamin A do I need?

The amount of vitamin A you need depends on your age and reproductive status. Recommended intakes for vitamin A for people aged 14 years and older range between 700 and 900 micrograms (mcg) of retinol activity equivalents (RAE) per day. Recommended intakes for women who are nursing range between 1,200 and 1,300 RAE. Lower values are recommended for infants and children younger than 14.

However, the vitamin A content of foods and dietary supplements is given on product labels in international units (IU), not mcg RAE. Converting between IU and mcg RAE is not easy. A varied diet with 900 mcg RAE of vitamin A, for example, provides between 3,000 and 36,000 IU of vitamin A depending on the foods consumed. See our Health Professional Fact Sheet on Vitamin A for more details.

For adults and children aged 4 years and older, the U.S. Food and Drug Administration has established a vitamin A Daily Value (DV) of 5,000 IU from a varied diet of both plant and animal foods. DVs are not recommended intakes; they don't vary by age and sex, for example. But trying to reach 100% of the DV each day, on average, is useful to help you get enough vitamin A. For more information on DVs, see our Frequently Asked Questions page.

What foods provide vitamin A?

Vitamin A is found naturally in many foods and is added to some foods, such as milk and cereal. You can get recommended amounts of vitamin A by eating a variety of foods, including the following:

Beef liver and other organ meats (but these foods are also high in cholesterol, so limit the amount you eat).

Some types of fish, such as salmon.

Green leafy vegetables and other green, orange, and yellow vegetables, such as broccoli, carrots, and squash.

Fruits, including cantaloupe, apricots, and mangos.

Dairy products, which are among the major sources of vitamin A for Americans.

Fortified breakfast cereals.

Am I getting enough vitamin A?

Most people in the United States get enough vitamin A from the foods they eat, and vitamin A deficiency is rare. However, certain groups of people are more likely than others to have trouble getting enough vitamin A:

Premature infants, who often have low levels of vitamin A in their first year.

Infants, young children, pregnant women, and breastfeeding women in developing countries.

People with cystic fibrosis.

What happens if I don't get enough vitamin A?

Vitamin A deficiency is rare in the United States, although it is common in many developing countries. The most common symptom of vitamin A deficiency in young children and pregnant women is an eye condition called xerophthalmia. Xerophthalmia is the inability to see in low light, and it can lead to blindness if it isn't treated.

What are some effects of vitamin A on health?

Scientists are studying vitamin A to understand how it affects health. Here are some examples of what this research has shown.

Cancer

People who eat a lot of *foods* containing beta-carotene might have a lower risk of certain kinds of cancer, such as lung cancer or prostate cancer. But studies to date have not shown that vitamin A or beta-carotene *supplements* can help prevent cancer or lower the chances of dying from this disease. In fact, studies show that smokers who take high doses of beta-carotene supplements have an *increased* risk of lung cancer.

Age-Related Macular Degeneration

Age-related macular degeneration (AMD), or the loss of central vision as people age, is one of the most common causes of vision loss in older people. Among people with AMD, a supplement containing antioxidants, zinc, and copper with or without beta-carotene has shown promise for slowing down the rate of vision loss.

Measles

When children with vitamin A deficiency (which is rare in North America) get measles, the disease tends to be more severe. In these children, taking supplements with high doses of vitamin A can shorten the fever and diarrhea caused by measles. These supplements can also lower the risk of death in children with measles who live in developing countries where vitamin A deficiency is common.

Can vitamin A be harmful?

Yes, high intakes of some forms of vitamin A can be harmful.

Getting too much preformed vitamin A (usually from supplements or certain medicines) can cause dizziness, nausea, headaches, coma, and even death. High intakes of preformed vitamin A in pregnant women can also cause birth defects in their babies. Women who might be pregnant should not take high doses of vitamin A supplements.

Consuming high amounts of beta-carotene or other forms of provitamin A can turn the skin yellow-orange, but this condition is harmless. High intakes of beta-carotene do not cause birth defects or the other more serious effects

caused by getting too much preformed vitamin A.

The safe upper limits for preformed vitamin A in IU are listed below. These levels do not apply to people who are taking vitamin A for medical reasons under the care of a doctor. Safe upper limits for beta-carotene and other forms of provitamin A have not been established.

Life Stage	Upper Safe Limit
Birth to 12 months	2,000 IU
Children 1–3 years	2,000 IU
Children 4–8 years	3,000 IU
Children 9–13 years	5,667 IU
Teens 14–18 years	9,333 IU
Adults 19 years and older	10,000 IU

Are there any interactions with vitamin A that I should know about?

Yes, vitamin A supplements can interact or interfere with medicines you take. Here are several examples:

Orlistat (Alli®, Xenical®), a weight-loss drug, can decrease the absorption of vitamin A, causing low blood levels in some people.

Several synthetic forms of vitamin A are used in prescription medicines. Examples are the psoriasis treatment acitretin (Soriatane®) and bexarotene (Targretin®), used to treat the skin effects of T-cell lymphoma. Taking these medicines in combination with a vitamin A supplement can cause dangerously high levels of vitamin A in the blood.

Tell your doctor, pharmacist, and other health care providers about any dietary supplements and medicines you take. They can tell you if those dietary supplements might interact or interfere with your prescription or over-the-counter medicines or if the medicines might interfere with how your body absorbs, uses, or breaks down nutrients.

Vitamin C

What is vitamin C and what does it do?

Vitamin C, also known as ascorbic acid, is a water-soluble nutrient found in some foods. In the body, it acts as an antioxidant, helping to protect cells from the damage caused by free radicals. Free radicals are compounds formed when our bodies convert the food we eat into energy. People are also exposed to free radicals in the environment from cigarette smoke, air pollution, and ultraviolet light from the sun.

The body also needs vitamin C to make collagen, a protein required to help wounds heal. In addition, vitamin C improves the absorption of iron from plant-based foods and helps the immune system work properly to protect the body from disease.

How much vitamin C do I need?

The amount of vitamin C you need each day depends on your age. Average daily recommended amounts for different ages are listed below in milligrams (mg).

Life Stage	Recommended Amount
Birth to 6 months	40 mg
Infants 7–12 months	50 mg
Children 1–3 years	15 mg
Children 4–8 years	25 mg
Children 9–13 years	45 mg
Teens 14–18 years (boys)	75 mg
Teens 14–18 years (girls)	65 mg
Adults (men)	90 mg
Adults (women)	75 mg
Pregnant teens	80 mg
Pregnant women	85 mg
Breastfeeding teens	115 mg
Breastfeeding women	120 mg

If you smoke, add 35 mg to the above values to calculate your total daily recommended amount.

What foods provide vitamin C?

Fruits and vegetables are the best sources of vitamin C. You can get recommended amounts of vitamin C by eating a variety of foods including the following:

- Citrus fruits (such as oranges and grapefruit) and their juices, as well as red and green pepper and kiwifruit, which have a lot of vitamin C.
- Other fruits and vegetables—such as broccoli, strawberries, cantaloupe, baked potatoes, and tomatoes—which also have vitamin C.
- Some foods and beverages that are fortified with vitamin C. To find out if vitamin C has been added to a food product, check the product labels.

The vitamin C content of food may be reduced by prolonged storage and by cooking. Steaming or microwaving may lessen cooking losses. Fortunately, many of the best food sources of vitamin C, such as fruits and vegetables, are usually eaten raw.

Am I getting enough vitamin C?

Most people in the United States get enough vitamin C from foods and beverages. However, certain groups of people are more likely than others to have trouble getting enough vitamin C:

- People who smoke and those who are exposed to secondhand smoke, in part because smoke increases the amount of vitamin C that the body needs to repair damage caused by free radicals. People who smoke need 35 mg more vitamin C per day than nonsmokers.
- Infants who are fed evaporated or boiled cow's milk, because cow's milk has very little vitamin C and heat can destroy vitamin C. Cow's milk is not recommended for infants under 1 year of age. Breast milk and infant formula have adequate amounts of vitamin C.
- People who eat a very limited variety of food.
- People with certain medical conditions such as severe malabsorption, some types of cancer, and kidney disease requiring hemodialysis.

What happens if I don't get enough vitamin C?

Vitamin C deficiency is rare in the United States and Canada. People who get little or no vitamin C (below about 10 mg per day) for many weeks can get scurvy. Scurvy causes fatigue, inflammation of the gums, small red or purple spots on the skin, joint pain, poor wound healing, and corkscrew hairs. Additional signs of scurvy include depression as well as swollen, bleeding gums and loosening or loss of teeth. People with scurvy can also develop anemia. Scurvy is fatal if it is not treated.

What are some effects of vitamin C on health?

Scientists are studying vitamin C to understand how it affects health. Here are several examples of what this research has shown.

Cancer prevention and treatment

People with high intakes of vitamin C from fruits and vegetables might have a lower risk of getting many types of cancer, such as lung, breast, and colon cancer. However, taking vitamin C supplements, with or without other antioxidants, doesn't seem to protect people from getting cancer.

It is not clear whether taking high doses of vitamin C is helpful as a treatment for cancer. Vitamin C's effects appear to depend on how it is administered to the patient. Oral doses of vitamin C can't raise blood levels of vitamin C nearly as high as intravenous doses given through injections. A few studies in animals and test tubes indicate that very high blood levels of vitamin C might shrink tumors. But more research is needed to determine whether high-dose intravenous vitamin C helps treat cancer in people.

Vitamin C dietary supplements and other antioxidants might interact with chemotherapy and radiation therapy for cancer. People being treated for cancer should talk with their oncologist before taking vitamin C or other antioxidant supplements, especially in high doses.

Cardiovascular disease

People who eat lots of fruits and vegetables seem to have a lower risk of cardiovascular disease. Researchers believe that the antioxidant content of these foods might be partly responsible for this association because oxidative damage is a major cause of cardiovascular disease. However, scientists aren't sure whether vitamin C itself, either from food or supplements, helps protect people from cardiovascular disease. It is also not clear whether vitamin C helps prevent cardiovascular disease from getting worse in people who already have it.

Age-related macular degeneration (AMD) and cataracts

AMD and cataracts are two of the leading causes of vision loss in older people. Researchers do not believe that vitamin C and other antioxidants affect the risk of getting AMD. However, research suggests that vitamin C combined with other nutrients might help keep early AMD from worsening into advanced AMD.

In a large study, older people with AMD who took a daily dietary supplement with 500 mg vitamin C, 80 mg zinc, 400 IU vitamin E, 15 mg beta-carotene, and 2 mg copper for about 6 years had a lower chance of developing advanced AMD. They also had less vision loss than those who did not take the dietary supplement.

More research is needed before doctors can recommend dietary supplements containing vitamin C for patients with AMD. However, people who have or are developing the disease might want to talk with their doctor about taking dietary supplements.

The relationship between vitamin C and cataract formation is unclear. Some studies show that people who get more vitamin C from foods have a lower risk of getting cataracts. But further research is needed to clarify this association and to determine whether vitamin C supplements affect the risk of getting cataracts.

The common cold

Although vitamin C has long been a popular remedy for the common cold, research shows that for most people, vitamin C supplements do not reduce the risk of getting the common cold. However, people who take vitamin C supplements regularly might have slightly shorter colds or somewhat milder symptoms when they do have a cold. Using vitamin C supplements after cold symptoms start does not appear to be helpful.

Can vitamin C be harmful?

Taking too much vitamin C can cause diarrhea, nausea, and stomach cramps. In people with a condition called hemochromatosis, which causes the body to store too much iron, high doses of vitamin C could worsen iron overload and damage body tissues.

The safe upper limits for vitamin C are listed below:

Life Stage	Upper Safe Limit
Birth to 12 months	Not established
Children 1–3 years	400 mg
Children 4–8 years	650 mg
Children 9–13 years	1,200 mg
Teens 14–18 years	1,800 mg
Adults	2,000 mg

Are there any interactions with vitamin C that I should know about?

Vitamin C dietary supplements can interact or interfere with medicines that you take. Here are several examples:

- Vitamin C dietary supplements might interact with cancer treatments, such as chemotherapy and radiation therapy. It is not clear whether vitamin C might have the unwanted effect of protecting tumor cells from cancer treatments or whether it might help protect normal tissues from getting damaged. If you are being treated for cancer, check with your health care provider before taking vitamin C or other antioxidant supplements, especially in high doses.
- In one study, vitamin C plus other antioxidants (such as vitamin E, selenium, and beta-carotene) reduced the heart-protective effects of two drugs taken in combination (a statin and niacin) to control blood-cholesterol levels. It is not known whether this interaction also occurs with other statins. Health care providers should monitor lipid levels in people taking both statins and antioxidant supplements.

Tell your doctor, pharmacist, and other health care providers about any dietary supplements and medicines you take. They can tell you if those dietary supplements might interact or interfere with your prescription or over-the-counter medicines or if the medicines might interfere with how your body absorbs, uses, or breaks down nutrients.

Vitamin E

What is vitamin E and what does it do?

Vitamin E is a fat-soluble nutrient found in many foods. In the body, it acts as an antioxidant, helping to protect cells from the damage caused by free radicals. Free radicals are compounds formed when our bodies convert the food we eat into energy. People are also exposed to free radicals in the environment from cigarette smoke, air pollution, and ultraviolet light from the sun.

The body also needs vitamin E to boost its immune system so that it can fight off invading bacteria and viruses. It helps to widen blood vessels and keep blood from clotting within them. In addition, cells use vitamin E to interact with each other and to carry out many important functions.

How much vitamin E do I need?

The amount of vitamin E you need each day depends on your age. Average daily recommended intakes are listed below in milligrams (mg) and in International Units (IU). Package labels list the amount of vitamin E in foods and dietary supplements in IU.

Life Stage	Recommended Amount
Birth to 6 months	4 mg (6 IU)
Infants 7–12 months	5 mg (7.5 IU)
Children 1–3 years	6 mg (9 IU)
Children 4–8 years	7 mg (10.4 IU)
Children 9–13 years	11 mg (16.4 IU)
Teens 14–18 years	15 mg (22.4 IU)
Adults	15 mg (22.4 IU)
Pregnant teens and women	15 mg (22.4 IU)
Breastfeeding teens and women	19 mg (28.4 IU)

What foods provide vitamin E?

Vitamin E is found naturally in foods and is added to some fortified foods. You can get recommended amounts of vitamin E by eating a variety of foods including the following:

- Vegetable oils like wheat germ, sunflower, and safflower oils are among the best sources of vitamin E. Corn and soybean oils also provide some vitamin E.
- Nuts (such as peanuts, hazelnuts, and, especially, almonds) and seeds (like sunflower seeds) are also among the best sources of vitamin E.
- Green vegetables, such as spinach and broccoli, provide some vitamin E.
- Food companies add vitamin E to some breakfast cereals, fruit juices, margarines and spreads, and other foods. To find out which ones have vitamin E, check the product labels.

Magnesium

Introduction

Magnesium, an abundant mineral in the body, is naturally present in many foods, added to other food products, available as a dietary supplement, and present in some medicines (such as antacids and laxatives). Magnesium is a cofactor in more than 300 enzyme systems that regulate diverse biochemical reactions in the body, including protein synthesis, muscle and nerve function, blood glucose control, and blood pressure regulation [1-3]. Magnesium is required for energy production, oxidative phosphorylation, and glycolysis. It contributes to the structural development of bone and is required for the synthesis of DNA, RNA, and the antioxidant glutathione. Magnesium also plays a role in the active transport of calcium and potassium ions across cell membranes, a process that is important to nerve impulse conduction, muscle contraction, and normal heart rhythm [3].

An adult body contains approximately 25 g magnesium, with 50% to 60% present in the bones and most of the rest in soft tissues [4]. Less than 1% of total magnesium is in blood serum, and these levels are kept under tight control. Normal serum magnesium concentrations range between 0.75 and 0.95 millimoles (mmol)/L [1,5]. Hypomagnesemia is defined as a serum magnesium level less than 0.75 mmol/L [6]. Magnesium homeostasis is largely controlled by the kidney, which typically excretes about 120 mg magnesium into the urine each day [2]. Urinary excretion is reduced when magnesium status is low [1].

Assessing magnesium status is difficult because most magnesium is inside cells or in bone [3]. The most commonly used and readily available method for assessing magnesium status is measurement of serum magnesium concentration, even though serum levels have little correlation with total body magnesium levels or concentrations in specific tissues [6]. Other methods for assessing magnesium status include measuring magnesium concentrations in erythrocytes, saliva, and urine; measuring ionized magnesium concentrations in blood, plasma, or serum; and conducting a magnesium-loading (or "tolerance") test. No single method is considered satisfactory [7]. Some experts [4] but not others [3] consider the tolerance test (in which urinary magnesium is measured after parenteral infusion of a dose of magnesium) to be the best method to assess magnesium status in adults. To comprehensively evaluate magnesium status, both laboratory tests and a clinical assessment might be required [6].

Recommended Intakes

Intake recommendations for magnesium and other nutrients are provided in the Dietary Reference Intakes (DRIs) developed by the Food and Nutrition Board (FNB) at the Institute of Medicine of the National Academies (formerly National Academy of Sciences) [1]. DRI is the general term for a set of reference values used to plan and assess nutrient intakes of healthy people. These values, which vary by age and sex, include:

- Recommended Dietary Allowance (RDA): average daily level of intake sufficient to meet the nutrient requirements of nearly all (97%–98%) healthy individuals.
- Adequate Intake (AI): established when evidence is insufficient to develop an RDA and is set at a level assumed to ensure nutritional adequacy.
- Estimated Average Requirement (EAR): average daily level of intake estimated to meet the requirements of 50% of healthy individuals. It is usually used to assess the adequacy of nutrient intakes in population groups but not individuals.
- Tolerable Upper Intake Level (UL): maximum daily intake unlikely to cause adverse health effects.

Table 1 lists the current RDAs for magnesium [1]. For infants from birth to 12 months, the FNB established an AI for magnesium that is equivalent to the mean intake of magnesium in healthy, breastfed infants, with added solid foods for ages 7–12 months.

Age	Male	Female	Pregnancy	Lactation
Birth to 6 months	30 mg*	30 mg*		
7–12 months	75 mg*	75 mg*		
1–3 years	80 mg	80 mg		
4–8 years	130 mg	130 mg		
9–13 years	240 mg	240 mg		
14–18 years	410 mg	360 mg	400 mg	360 mg
19–30 years	400 mg	310 mg	350 mg	310 mg
31–50 years	420 mg	320 mg	360 mg	320 mg
51+ years	420 mg	320 mg		

Table 1: Recommended Dietary Allowances (RDAs) for Magnesium [1]

*Adequate Intake (AI)

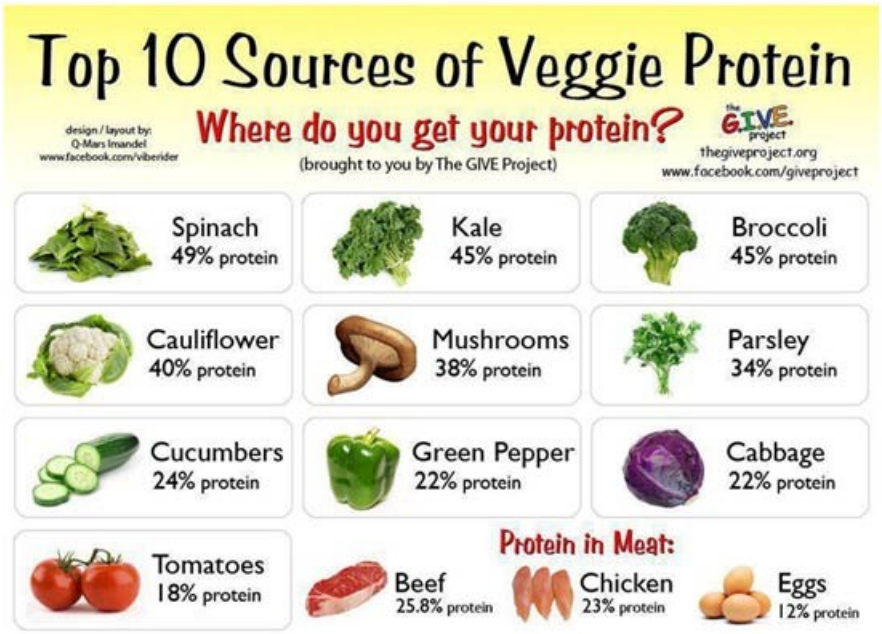
Sources of Magnesium

Food

Magnesium is widely distributed in plant and animal foods and in beverages. Green leafy vegetables, such as spinach, legumes, nuts, seeds, and whole grains, are good sources [1,3]. In general, foods containing dietary fiber provide magnesium. Magnesium is also added to some breakfast cereals and other fortified foods. Some types of food processing, such as refining grains in ways that remove the nutrient-rich germ and bran, lower magnesium content substantially [1]. Selected food sources of magnesium are listed in Table 2.

Tap, mineral, and bottled waters can also be sources of magnesium, but the amount of magnesium in water varies by source and brand (ranging from 1 mg/L to more than 120 mg/L) [8].

Approximately 30% to 40% of the dietary magnesium consumed is typically absorbed by the body [2,9].



Food	Milligrams	Percent
Almonds, dry roasted, 1 ounce	80	20
Spinach, boiled, ½ cup	78	20
Cashews, dry roasted, 1 ounce	74	19
Peanuts, oil roasted, ¼ cup	63	16
Cereal, shredded wheat, 2 large biscuits	61	15
Soymilk, plain or vanilla, 1 cup	61	15
Black beans, cooked, ½ cup	60	15
Edamame, shelled, cooked, ½ cup	50	13
Peanut butter, smooth, 2 tablespoons	49	12
Bread, whole wheat, 2 slices	46	12
Avocado, cubed, 1 cup	44	15
Potato, baked with skin, 3.5 ounces	43	11
Rice, brown, cooked, ½ cup	42	11
Yogurt, plain, low fat, 8 ounces	42	11
Breakfast cereals, fortified with 10% of the DV for mag-	40	10
Oatmeal, instant, 1 packet	36	9
Kidney beans, canned, ½ cup	35	9
Banana, 1 medium	32	8
Salmon, Atlantic, farmed, cooked, 3 ounces	26	7
Milk, 1 cup	24–27	6–7
Halibut, cooked, 3 ounces	24	6
Raisins, ½ cup	23	6
Chicken breast, roasted, 3 ounces	22	6
Beef, ground, 90% lean, pan broiled, 3 ounces	20	5
Broccoli, chopped and cooked, ½ cup	12	3
Rice, white, cooked, ½ cup	10	3
Apple, 1 medium	9	2
Carrot, raw, 1 medium	7	2

Table 2: Selected Food Sources of Magnesium [10]

*DV = Daily Value. DVs were developed by the U.S. Food and Drug Administration (FDA) to help consumers compare the nutrient contents of products within the context of a total diet. The DV for magnesium is 400 mg for adults and children aged 4 and older. However, the FDA does not require food labels to list magnesium content unless a food has been fortified with this nutrient. Foods providing 20% or more of the DV are considered to be high sources of a nutrient.

The U.S. Department of Agriculture's (USDA's) Nutrient Database Web site [10] lists the nutrient content of many foods and provides a comprehensive list of foods containing magnesium.

Dietary supplements

Magnesium supplements are available in a variety of forms, including magnesium oxide, citrate, and chloride [2,3]. The Supplement Facts panel on a dietary supplement label declares the amount of *elemental* magnesium in the product, not the weight of the entire magnesium-containing compound.

Absorption of magnesium from different kinds of magnesium supplements varies. Forms of magnesium that dissolve well in liquid are more completely absorbed in the gut than less soluble forms [2,11]. Small studies have found that magnesium in the aspartate, citrate, lactate, and chloride forms is absorbed more completely and is more bioavailable than magnesium oxide and magnesium sulfate [11-15]. One study found that very high doses of zinc from supplements (142 mg/day) can interfere with magnesium absorption and disrupt the magnesium balance in the body [16].

Medicines

Magnesium is a primary ingredient in some laxatives [17]. Phillips' Milk of Magnesia®, for example, provides 500 mg elemental magnesium (as magnesium hydroxide) per tablespoon; the directions advise taking up to 4 tablespoons/day for adolescents and adults [18]. (Although such a dose of magnesium is well above the safe upper level, some of the magnesium is not absorbed because of the medication's laxative effect.) Magnesium is also included in some remedies for heartburn and upset stomach due to acid indigestion [17]. Extra-strength Rolaids®, for example, provides 55 mg elemental magnesium (as magnesium hydroxide) per tablet [19], although Tums® is magnesium free [20].

Magnesium Intakes and Status

Dietary surveys of people in the United States consistently show that intakes of magnesium are lower than recommended amounts. An analysis of data from the National Health and Nutrition Examination Survey (NHANES) of 2005–2006 found that a majority of Americans of all ages ingest less magnesium from food than their respective EARs; adult men aged 71 years and older and adolescent females are most likely to have low intakes [21]. In a study using data from NHANES 2003–2006 to assess mineral intakes among adults, average intakes of magnesium from food alone were higher among users of dietary supplements (350 mg for men and 267 mg for women, equal to or slightly exceeding their respective EARs) than among nonusers (268 mg for men and 234 for women) [22]. When supplements were included, average total intakes of magnesium were 449 mg for men and 387 mg for women, well above EAR levels.

No current data on magnesium status in the United States are available. Determining dietary intake of magnesium is the usual proxy for assessing magnesium status. NHANES has not determined serum magnesium levels in its participants since 1974 [23], and magnesium is not evaluated in routine electrolyte testing in hospitals and clinics [2].

Magnesium Deficiency

Symptomatic magnesium deficiency due to low dietary intake in otherwise-healthy people is uncommon because the kidneys limit urinary excretion of this mineral [3]. However, habitually low intakes or excessive losses of magnesium due to certain health conditions, chronic alcoholism, and/or the use of certain medications can lead to magnesium deficiency.

Early signs of magnesium deficiency include loss of appetite, nausea, vomiting, fatigue, and weakness. As magnesium deficiency worsens, numbness, tingling, muscle contractions and cramps, seizures, personality changes, abnormal heart rhythms, and coronary spasms can occur [1,2]. Severe magnesium deficiency can result in hypocalcemia or hypokalemia (low serum calcium or potassium levels, respectively) because mineral homeostasis is disrupted [2].

Groups at Risk of Magnesium Inadequacy

Magnesium inadequacy can occur when intakes fall below the RDA but are above the amount required to prevent overt deficiency. The following groups are more likely than others to be at risk of magnesium inadequacy because they typically consume insufficient amounts or they have medical conditions (or take medications) that reduce magnesium absorption from the gut or increase losses from the body.

People with gastrointestinal diseases

The chronic diarrhea and fat malabsorption resulting from Crohn's disease, gluten-sensitive enteropathy (celiac disease), and regional enteritis can lead to magnesium depletion over time [2]. Resection or bypass of the small intestine, especially the ileum, typically leads to malabsorption and magnesium loss [2].

People with type 2 diabetes

Magnesium deficits and increased urinary magnesium excretion can occur in people with insulin resistance and/or type 2 diabetes [24,25]. The magnesium loss appears to be secondary to higher concentrations of glucose in the kidney that increase urine output [2].

People with alcohol dependence

Magnesium deficiency is common in people with chronic alcoholism [2]. In these individuals, poor dietary intake and nutritional status; gastrointestinal problems, including vomiting, diarrhea, and steatorrhea (fatty stools) resulting from pancreatitis; renal dysfunction with excess excretion of magnesium into the urine; phosphate depletion; vitamin D deficiency; acute alcoholic ketoacidosis; and hyperaldosteronism secondary to liver disease can all contribute to decreased magnesium status [2,26].

Older adults

Older adults have lower dietary intakes of magnesium than younger adults [20,27]. In addition, magnesium absorption from the gut decreases and renal magnesium excretion increases with age [28]. Older adults are also more likely to have chronic diseases or take medications that alter magnesium status, which can increase their risk of magnesium depletion [1,29].

Magnesium and Health

Habitually low intakes of magnesium induce changes in biochemical pathways that can increase the risk of illness over time. This section focuses on four diseases and disorders in which magnesium might be involved: hypertension and cardiovascular disease, type 2 diabetes, osteoporosis, and migraine headaches.

Hypertension and cardiovascular disease

Hypertension is a major risk factor for heart disease and stroke. Studies to date, however, have found that magnesium supplementation lowers blood pressure, at best, to only a small extent. A meta-analysis of 12 clinical trials found that magnesium supplementation for 8–26 weeks in 545 hypertensive participants resulted in only a small reduction (2.2 mmHg) in diastolic blood pressure [30]. The dose of magnesium ranged from approximately 243 to 973 mg/day. The authors of another meta-analysis of 22 studies with 1,173 normotensive and hypertensive adults concluded that magnesium supplementation for 3–24 weeks decreased systolic blood pressure by 3–4 mmHg and diastolic blood pressure by 2–3 mmHg [31]. The effects were somewhat larger when supplemental magnesium intakes of the participants in the nine crossover-design trials exceeded 370 mg/day. A diet containing more magnesium because of added fruits and vegetables, more low-fat or non-fat dairy products, and less fat overall was shown to lower systolic and diastolic blood pressure by an average of 5.5 and 3.0 mmHg, respectively [32]. However, this Dietary Approaches to Stop Hypertension (DASH) diet also increases intakes of other nutrients, such as potassium and calcium, that are associated with reductions in blood pressure, so any independent contribution of magnesium cannot be determined.

Several prospective studies have examined associations between magnesium intakes and heart disease. The Atherosclerosis Risk in Communities study assessed heart disease risk factors and levels of serum magnesium in a cohort of 14,232 white and African-American men and women aged 45 to 64 years at baseline [33]. Over an average of 12 years of follow-up, individuals in the highest quartile of the normal physiologic range of serum magnesium (at least 0.88 mmol/L) had a 38% reduced risk of sudden cardiac death compared with individuals in the lowest quartile (0.75 mmol/

L or less). However, dietary magnesium intakes had no association with risk of sudden cardiac death. Another prospective study tracked 88,375 female nurses in the United States to determine whether serum magnesium levels measured early in the study and magnesium intakes from food and supplements assessed every 2 to 4 years were associated with sudden cardiac death over 26 years of follow-up [34]. Women in the highest compared with the lowest quartile of ingested and plasma magnesium concentrations had a 34% and 77% lower risk of sudden cardiac death, respectively. Another prospective population study of 7,664 adults aged 20 to 75 years in the Netherlands who did not have cardiovascular disease found that low urinary magnesium excretion levels (a marker for low dietary magnesium intake) were associated with a higher risk of ischemic heart disease over a median follow-up period of 10.5 years. Plasma magnesium concentrations were not associated with risk of ischemic heart disease [35]. A systematic review and meta-analysis of prospective studies found that higher serum levels of magnesium were significantly associated with a lower risk of cardiovascular disease, and higher dietary magnesium intakes (up to approximately 250 mg/day) were associated with a significantly lower risk of ischemic heart disease caused by a reduced blood supply to the heart muscle [36].

Higher magnesium intakes might reduce the risk of stroke. In a meta-analysis of 7 prospective trials with a total of 241,378 participants, an additional 100 mg/day magnesium in the diet was associated with an 8% decreased risk of total stroke, especially ischemic rather than hemorrhagic stroke [37]. One limitation of such observational studies, however, is the possibility of confounding with other nutrients or dietary components that could also affect the risk of stroke.

A large, well-designed clinical trial is needed to better understand the contributions of magnesium from food and dietary supplements to heart health and the primary prevention of cardiovascular disease [38].

Type 2 diabetes

Diets with higher amounts of magnesium are associated with a significantly lower risk of diabetes, possibly because of the important role of magnesium in glucose metabolism [39,40]. Hypomagnesemia might worsen insulin resistance, a condition that often precedes diabetes, or it might be a consequence of insulin resistance [41]. Diabetes leads to increased urinary losses of magnesium, and the subsequent magnesium inadequacy might impair insulin secretion and action, thereby worsening diabetes control [3].

Most investigations of magnesium intake and risk of type 2 diabetes have been prospective cohort studies. A meta-analysis of 7 of these studies, which included 286,668 patients and 10,912 cases of diabetes over 6 to 17 years of follow-up, found that a 100 mg/day increase in total magnesium intake decreased the risk of diabetes by a statistically significant 15% [39]. Another meta-analysis of 8 prospective cohort studies that followed 271,869 men and women over 4 to 18 years found a significant inverse association between magnesium intake from food and risk of type 2 diabetes; the relative risk reduction was 23% when the highest to lowest intakes were compared [42].

A 2011 meta-analysis of prospective cohort studies of the association between magnesium intake and risk of type 2 diabetes included 13 studies with a total of 536,318 participants and 24,516 cases of diabetes [43]. The mean length of follow-up ranged from 4 to 20 years. Investigators found an inverse association between magnesium intake and risk of type 2 diabetes in a dose-responsive fashion, but this association achieved statistical significance only in overweight (body mass index [BMI] 25 or higher) but not normal-weight individuals (BMI less than 25). Again, a limitation of these observational studies is the possibility of confounding with other dietary components or lifestyle or environmental variables that are correlated with magnesium intake.

Only a few small, short-term clinical trials have examined the potential effects of supplemental magnesium on control of type 2 diabetes [40]. For example, 128 patients with poorly controlled diabetes in a Brazilian clinical trial received a placebo or a supplement containing either 500 mg/day or 1,000 mg/day magnesium oxide (providing 300 or 600 mg elemental magnesium, respectively) [44]. After 30 days of supplementation, plasma, cellular, and urine magnesium levels increased in participants receiving the larger dose of the supplement, and their glycemic control improved. In another small trial in Mexico, participants with type 2 diabetes and hypomagnesemia who received a liquid supplement of magnesium chloride (providing 300 mg/day elemental magnesium) for 16 weeks showed significant reductions in fasting glucose and glycosylated hemoglobin concentrations compared with participants receiving a placebo, and their serum magnesium levels became normal [45]. Larger and longer clinical trials are required to determine whether magnesium supplementation is of value for treating or controlling type 2 diabetes.

In 2008, the American Diabetes Association stated in its nutrition recommendations for people with diabetes, "Health care providers should focus on nutrition counseling rather than micronutrient supplementation in order to reach metabolic control of their patients. Research including long-term trials is needed to assess the safety and potentially beneficial role of chromium, magnesium, and antioxidant supplements and other complementary therapies in the management of type 2 diabetes" [46].

Osteoporosis

Magnesium is involved in bone formation and influences the activities of osteoblasts and osteoclasts [47]. Magnesium also affects the concentrations of both parathyroid hormone and the active form of vitamin D, which are major regulators of bone homeostasis. Several population-based studies have found positive associations between magnesium intake and bone mineral density in both men and women [48]. Other research has found that women with osteoporosis have lower serum magnesium levels than women with osteopenia and those who do not have osteoporosis or osteopenia [49]. These and other findings indicate that magnesium deficiency might be a risk factor for osteoporosis [47].

Although limited in number, studies suggest that increasing magnesium intakes from food or supplements might increase bone mineral density in postmenopausal and elderly women [1]. For example, one short-term study found that 290 mg/day elemental magnesium (as magnesium citrate) for 30 days in 20 postmenopausal women with osteoporosis suppressed bone turnover compared with placebo, suggesting that bone loss decreased [50].

Diets that provide recommended levels of magnesium enhance bone health, but further research is needed to elucidate the role of magnesium in the prevention and management of osteoporosis.

Migraine headaches

Magnesium deficiency is related to factors that promote headaches, including neurotransmitter release and vasoconstriction [51]. People who experience migraine headaches have lower levels of serum and tissue magnesium than those who do not.

However, research on the use of magnesium supplements to prevent or reduce symptoms of migraine headaches is limited. Three of four small, short-term, placebo-controlled trials found modest reductions in the frequency of migraines in patients given up to 600 mg/day magnesium [51]. The authors of a review on migraine prophylaxis suggested that taking 300 mg magnesium twice a day, either alone or in combination with medication, can prevent migraines [52].

In their evidence-based guideline update, the American Academy of Neurology and the American Headache Society concluded that magnesium therapy is "probably effective" for migraine prevention [53]. Because the typical dose of magnesium used for migraine prevention exceeds the UL, this treatment should be used only under the direction and supervision of a healthcare provider.

Health Risks from Excessive Magnesium

Too much magnesium from food does not pose a health risk in healthy individuals because the kidneys eliminate excess amounts in the urine [28]. However, high doses of magnesium from dietary supplements or medications often result in diarrhea that can be accompanied by nausea and abdominal cramping [1]. Forms of magnesium most commonly report-

ed to cause diarrhea include magnesium carbonate, chloride, gluconate, and oxide [11]. The diarrhea and laxative effects of magnesium salts are due to the osmotic activity of unabsorbed salts in the intestine and colon and the stimulation of gastric motility [54].

Very large doses of magnesium-containing laxatives and antacids (typically providing more than 5,000 mg/day magnesium) have been associated with magnesium toxicity [55], including fatal hypermagnesemia in a 28-month-old boy [56] and an elderly man [57]. Symptoms of magnesium toxicity, which usually develop after serum concentrations exceed 1.74–2.61 mmol/L, can include hypotension, nausea, vomiting, facial flushing, retention of urine, ileus, depression, and lethargy before progressing to muscle weakness, difficulty breathing, extreme hypotension, irregular heartbeat, and cardiac arrest [28]. The risk of magnesium toxicity increases with impaired renal function or kidney failure because the ability to remove excess magnesium is reduced or lost [1,28].

The FNB has established ULs for magnesium that apply *only to supplemental* magnesium for healthy infants, children, and adults (see Table 3) [1].

Age	Male	Female	Pregnant	Lactating
Birth to 12 months	None established	None established		
1–3 years	65 mg	65 mg		
4–8 years	110 mg	110 mg		
9–18 years	350 mg	350 mg	350 mg	350 mg
19+ years	350 mg	350 mg	350 mg	350 mg

Table 3: Tolerable Upper Intake Levels (ULs) for Supplemental Magnesium [1]

Interactions with Medications

Several types of medications have the potential to interact with magnesium supplements or affect magnesium status. A few examples are provided below. People taking these and other medications on a regular basis should discuss their magnesium intakes with their healthcare providers.

Bisphosphonates

Magnesium-rich supplements or medications can decrease the absorption of oral bisphosphonates, such as alendronate (Fosamax®), used to treat osteoporosis [58]. Use of magnesium-rich supplements or medications and oral bisphosphonates should be separated by at least 2 hours [54].

Antibiotics

Magnesium can form insoluble complexes with tetracyclines, such as demeclocycline (Declomycin®) and doxycycline (Vibramycin®), as well as quinolone antibiotics, such as ciprofloxacin (Cipro®) and levofloxacin (Levaquin®). These antibiotics should be taken at least 2 hours before or 4–6 hours after a magnesium-containing supplement [54,59].

Diuretics

Chronic treatment with loop diuretics, such as furosemide (Lasix®) and bumetanide (Bumex®), and thiazide diuretics, such as hydrochlorothiazide (Aquazide H®) and ethacrynic acid (Edecrin®), can increase the loss of magnesium in urine and lead to magnesium depletion [60]. In contrast, potassium-sparing diuretics, such as amiloride (Midamor®) and spironolactone (Aldactone®), reduce magnesium excretion [60].

Proton pump inhibitors

Prescription proton pump inhibitor (PPI) drugs, such as esomeprazole magnesium (Nexium®) and lansoprazole (Prevacid®), when taken for prolonged periods (typically more than a year) can cause hypomagnesemia [61]. In cases that FDA reviewed, magnesium supplements often raised the low serum magnesium levels caused by PPIs. However, in 25% of the cases, supplements did not raise magnesium levels and the patients had to discontinue the PPI. FDA advises healthcare professionals to consider measuring patients' serum magnesium levels prior to initiating long-term PPI treatment and to check magnesium levels in these patients periodically [61].

Magnesium and Healthful Diets

According to the 2010 *Dietary Guidelines for Americans*, "nutrients should come primarily from foods. Foods in nutrient-dense, mostly intact forms contain not only the essential vitamins and minerals that are often contained in nutrient supplements, but also dietary fiber and other naturally occurring substances that may have positive health effects. ...Dietary supplements...may be advantageous in specific situations to increase intake of a specific vitamin or mineral."

The *Dietary Guidelines for Americans* describes a healthy diet as one that:

- Emphasizes a variety of fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products.
  Whole grains and dark-green, leafy vegetables are good sources of magnesium. Low-fat milk and yogurt contain magnesium as well. Some ready-to-eat breakfast cereals are fortified with magnesium.
- Includes lean meats, poultry, fish, beans, eggs, and nuts.
  Dried beans and legumes (such as soybeans, baked beans, lentils, and peanuts) and nuts (such as almonds and cashews) provide magnesium.
- Is low in saturated fats, *trans* fats, cholesterol, salt (sodium), and added sugars.
- Stays within your daily calorie needs.

For more information about building a healthful diet, refer to the *Dietary Guidelines for Americans* and the U.S. Department of Agriculture's food guidance system, ChooseMyPlate.gov.

Potassium

Potassium is a mineral necessary for the proper function of many of your body systems; it's also often referred to as one of the key electrolytes in your body. Potassium, along with sodium, the other electrolyte, plays a vital role in regulating the fluid levels in your body. Potassium has many roles and responsibilities within your body, these responsibilities include:

- Maintains the electrolyte balance in your body's cells
- Manages your blood pressure and keeps your heart functioning properly
- Assists nervous system by aiding in the correct function of tissues needed for sending nerve impulses

Helps the muscles contract

Releases energy from protein, fat and carbohydrates during the metabolic process

Aids in the waste removal process

Enhances muscle control, the growth and health of your cells

Promotes efficient cognitive functioning by helping to deliver oxygen to the brain

Effects of Deficiency of Potassium

Dietary deficiency of potassium can lead to variety of mental and physical problems for you. Mental symptoms can include insomnia, anorexia, depression and some nervous disorders. Physical symptoms include muscular cramps and twitching, fatigue, muscular weakness, poor reflexes, irregular heartbeat and other cardiovascular problems, fragile bones, lung and kidney failure and heart attack. If you experience any combination of these symptoms, you should speak with your doctor immediately. A simple blood test can determine if your potassium levels are too low or your sodium levels are too high.

Reasons for Deficiency of Potassium

There are several reasons for potential potassium deficiency. Among them include: excessive alcohol consumptions, high stress, poor overall health, diarrhea and vomiting for prolong periods. During periods of diarrhea or vomiting or excessive sweating, potassium levels can fall more quickly and, therefore, need to be replenished as quickly as possible. This is very common in children, infants and the elderly.

The many preventable reasons for deficiency can include excessive caffeine consumption, imbalanced diet of excessive consumption of processed foods and excessive consumption of sodium. A balance has to be maintained between sodium and potassium, since consuming excess amounts of sodium can lead to an increase in your blood pressure.

Need to Maintain a Balance

The human body is an intricate system with sensitive chemical balances. For your body to be healthy, it's important that this delicate balance be maintained. Any disruption in the balance can have a cascading effect, with some more severe than others. To prevent any disruption or disturbance, it is vital to maintain a healthy diet. When you make sure to get the daily recommended total for potassium and stay below the daily recommend amount of sodium, you will be able to better maintain the balance your body needs to operate at optimal health.

The best way to maintain a healthy body is to have a nutrient-rich, well-balanced diet, while avoiding added sugars, junk foods, fats, and excessive carbohydrates.

Sources of Potassium

Potatoes

Bananas

Cooked spinach

Bamboo shoots

Oranges

Apricots

Prunes

Indulge in the foods above, and give your body the potassium it needs and deserves!

Here ya go, the 5 nutrients we need daily can be consumed with the plan below. It's not really a recipe per say, but it is a recipe for good health.

1/3 cup nuts

½ cup cooked or canned beans

1 cup steamed dark green vegetables

1 cup yellow/orange fruit or vegetable

1 cup fresh citrus juice (not from a can or carton or bottle) need to squeeze it yourself

If you include this little healthy plan every day, your body will be healthier and will function better.

Just Do It!